

A Bioluminescence Bathyphotometer for an Autonomous Underwater Vehicle

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LONG TERM GOALS

The central goal is to achieve standardization among oceanic bioluminescence measurements by developing a fully characterized bathyphotometer system (MDDBP) useful on a wide variety of marine platforms for both research and naval applications.

OBJECTIVES

Building on the experience of extensive sea tests on various platforms during the past year the design of the MDDBP has been finalized and production of a series of instruments for use by several ONR programs is under way.

APPROACH

The principal design changes instituted dealt with improvements in access for maintenance of the MDDBP measurement chamber, PMT masking, operator control over volume flow, increased memory and various programming improvements. These have during the year been tested in several field studies.

WORK COMPLETED

Excitation and flow characteristics in the measurement chamber were directly evaluated under laboratory conditions by image intensified video of cultured *Pyrocystis fusiformis* and *Gonyaulax polyedra* excited and entrained by the instrument, in consultation with Drs. Sally MacIntyre (UCSB) and Michael Latz and James Rohr (UCSD and SPAWARS San Diego). An additional capture efficiency test (Shindler Trap vs MDDBP with exhaust flow net) was conducted by Haddock and Herren in Monterey Bay, but is as yet unanalyzed. With the major increase of data storage obtained by conversion to flash memory it was possible to improve the signal integration time to 250 msc from 1s. This allows improved discrimination between the luminescence of dinoflagellates and brighter sources such as copepods and other zooplankters. Even with the earlier version this valuable discrimination was evident in AUV runs (Haddock). With this third design iteration the basic MDDBP is considered ready for general use.

RESULTS

Studies on several platforms in varied experimental environments and situations showed the MDDBP design to be widely applicable. During the year MDDBPs were used as follows:

1. On the ORCAS profiling mooring in the Gulf of Mexico and Monterey Bay. Dekshenieks (McManus), Donaghay, Sullivan and Weidemann
2. On the LEO-15 autonomous profiler (Moline, et al)
3. LEO-15 Hidex/MDDBP intercomparison (Heine, Herren, Widder and Case)
4. SPOKES bioluminescence program in Monterey Bay (Haddock, Herren and Case)
5. AOSN-2 2002 program bioluminescence component in Monterey Bay with MDDBPs operated from the Pt. Sur, a MBARI AUV and profiling mooring (Haddock, Herren and Case)

IMPACT/APPLICATIONS

It is believed that the MDDBP is now the most widely tested and characterized small bioluminescence bathyphotometer suitable for use on the most commonly used platforms. It is hoped utilization of these instruments will reduce much of the confusion arising from use of bathyphotometers of widely varying measuring characteristics in pure and applied studies of marine bioluminescence.

TRANSITIONS

MDDBPs have been or are potentially useful in studies of diver visibility, nocturnal coastal access, red tides, thin layers, and plankton **population** dynamics.

RELATED PROJECTS

1. Coastal Bioluminescence Prediction Network - N00014-02-1-0635
2. AOSN-II: Monterey Bay Predictive Skill Experiment – New ONR initiative

REFERENCES

Blackwell, S., J. Case, S. Glenn, J. Kohut, M. A. Moline, M. Purcell, O.M.E. Schofield and C. VonAlt (in press) A new AUV platform for studying nearshore bioluminescence structure. Proceedings 12th International Symposium on Bioluminescence and Chemiluminescence, (Kricka, L. J. and P. E. Stanley, editors). World Scientific, Singapore.

Herren, CM, JF Case, DV Holiday, C Greenlaw, D. McGehee and D. Lapota (2000) Fine-scale coastal bioluminescence using newly developed small-scale bathyphotometers. 11th Int. Symposium on Bioluminescence and Chemiluminescence. Monterey, CA

McManus, M., et al. (Submitted) Characteristics, distribution and persistence of thin layers over a 48 hour period. Marine Ecology Progress Series